



WHAT IS CASA?

Kevin Kloesel,
College of Geosciences, OU

Spanish for “house”

Questions?



University of
Massachusetts Amherst



University of Oklahoma



Colorado State University



University of
Puerto Rico Mayaguez

CASA is primarily supported by the Engineering Research Centers Program
of the National Science Foundation under NSF award number 0313747.



COLLABORATIVE ADAPTIVE SENSING of the ATMOSPHERE



Kevin Kloesel,
College of Geosciences, OU

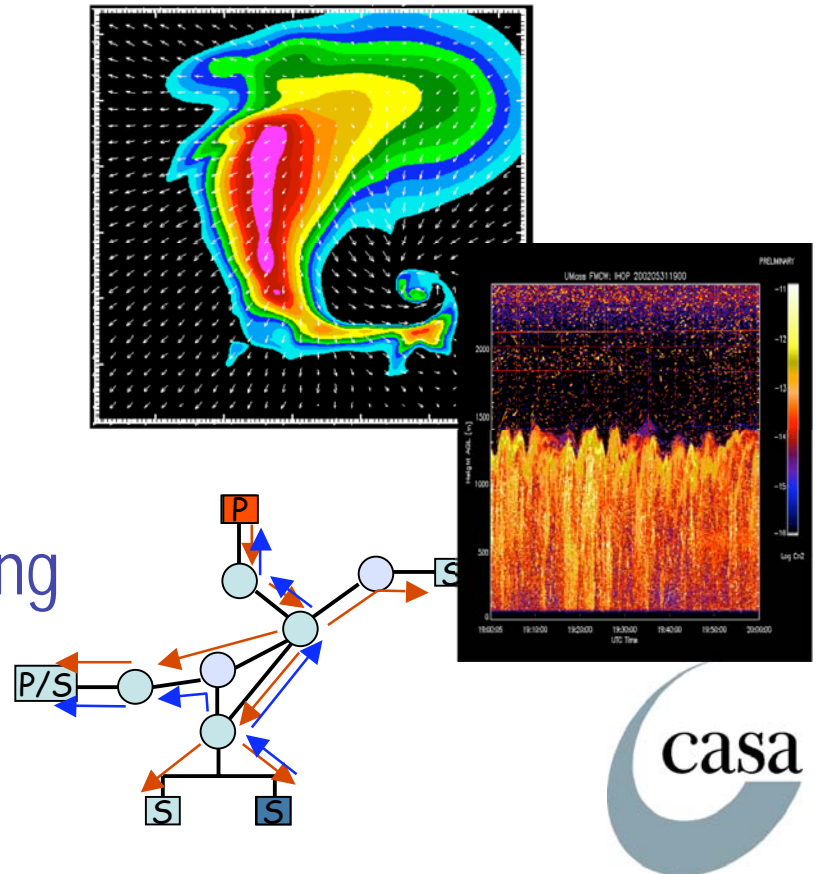
Presenting on behalf of a cast of thousands...

NSF - Engineering Research Centers

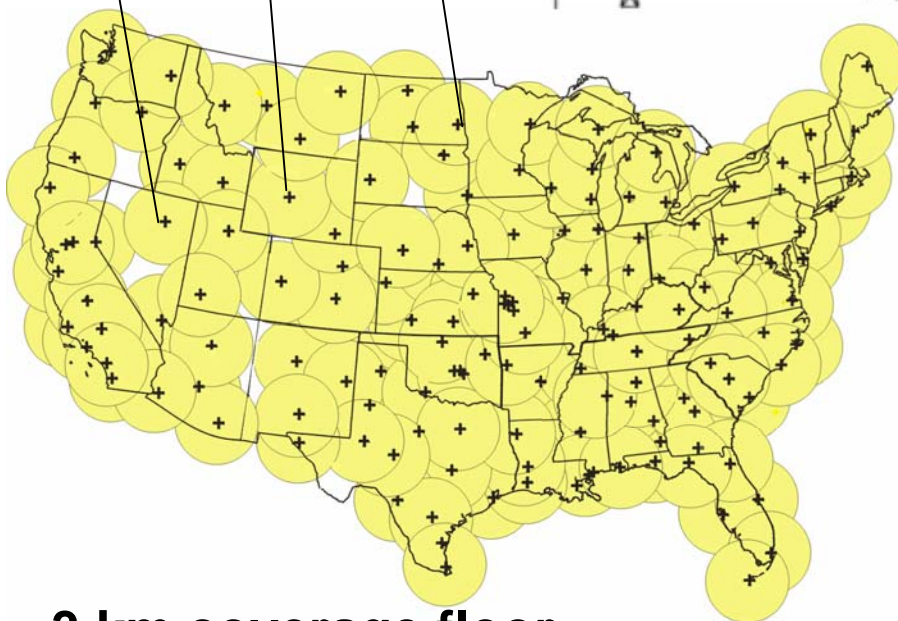
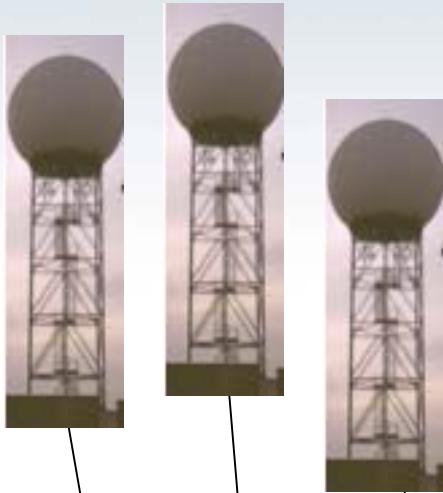
Research resulting in an unprecedented ability to observe the lower portion of the earth's atmosphere

... enabled by fundamental and integrated advances in

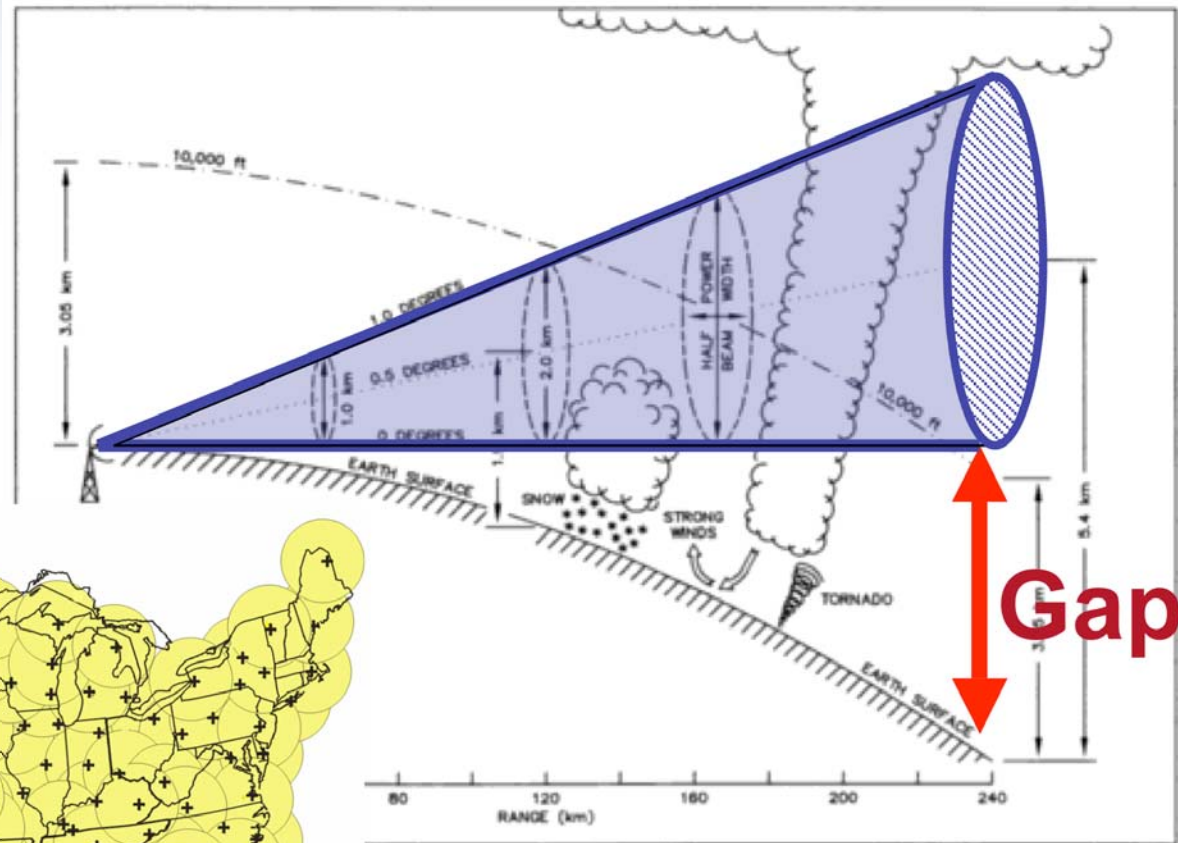
- remote sensing
- distributed networked computing
- atmospheric modeling and predicting



NEXRAD System Today



3 km coverage floor



it of range and earth curvature (with standard atmospheric refraction) on NEXRAD cross-beam
ther phenomena. Courtesy of SRI International.

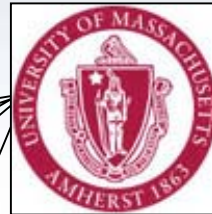
Earth curvature effects prevent 72% of the
troposphere below 1 km from being observed



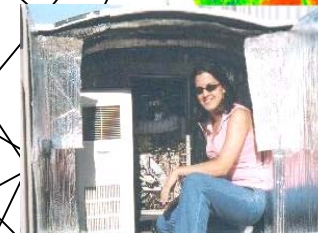
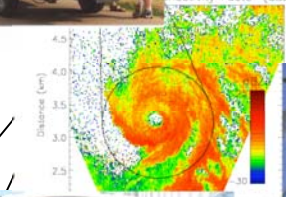
What's needed to solve this problem?

Remote sensing
Microwave engineering
Networking
Distributed systems
Numerical prediction
Emergency management
Radar meteorology
Quantitative inversion
Climate studies
Social impact
Antenna design

expertise



core partners



working
together 

End User Participant Research

- Oklahoma Department of Emergency Management - Paul Spencer (State EOC)
- Oklahoma Emergency Managers –in-depth interviews and survey interviews
- NWS Forecast Office Norman – Mike Foster (MIC), Dave Andra (SOO), Rick Smith (WCM)
- Baron Services – Greg Wilson
- Vieux and Associates – Jean Vieux



Objectives

1. Identify end users' perceptions regarding advantages and limitations of current weather observation and warning systems.
2. Identify end users' perceptions regarding how the media and public perceive, understand, and respond to weather forecasts and warning information.
3. Examine the communication process, from weather observations to the end users.
4. Policy determinations:
 - Who will make the decisions regarding the allocation of weather observation resources?
 - In the event of simultaneous weather threats, what priority criteria, should be established to determine the allocation of resources?



Results: In-depth Interviews

- NWS is seen as the appropriate organization to determine the allocation of system resources.
- The type of weather event and the population density of a region are important considerations in allocation of system resources.
- Precise tracking of tornados is important for Emergency Managers who must make safe shelter decisions when a county wide tornado warning is issued by the NWS.

"It would be great to be able to say that there is a large vortex up to a quarter mile wide centered at this intersection, and five minutes from now it's going to be at this intersection, and to be very specific in that way."



Results: In-depth Interviews

- More frequent updates for radar data would help Emergency Managers make decisions. Currently radar data is updated approximately every 5 minutes. Many cited one minute as an ideal update time.

“Quicker updates [of radar data] would be the number one thing for me. Because it’s a long five minutes when you have a tornado coming down your throat here, and you’re hitting the reload button...”

- Accessing DCAS Data - Sophisticated users want access to radar before it is extensively processed for their own algorithms and visualization products.
- Visualization of the weather phenomena was extremely important for emergency managers. They are looking for enhanced graphics in new products.



Results: In-depth Interviews

- Floods historically cause more damage and deaths; however, emergency managers interviewed consider tornados the most important weather event because of their unpredictable nature.

“if I don’t give the warning for a flood, I’m still going to be here tomorrow...if I don’t blow the sirens before the tornado hits the city limits, I won’t be here tomorrow.”



End User Integration Goals

- Incorporate end user needs into the system design from day one.
- Quantify the social and economic impacts to support system trade-offs and eventual technology transfer.
- Effective application of weather technology and information.
- Generating effective public response to hazards and disasters.



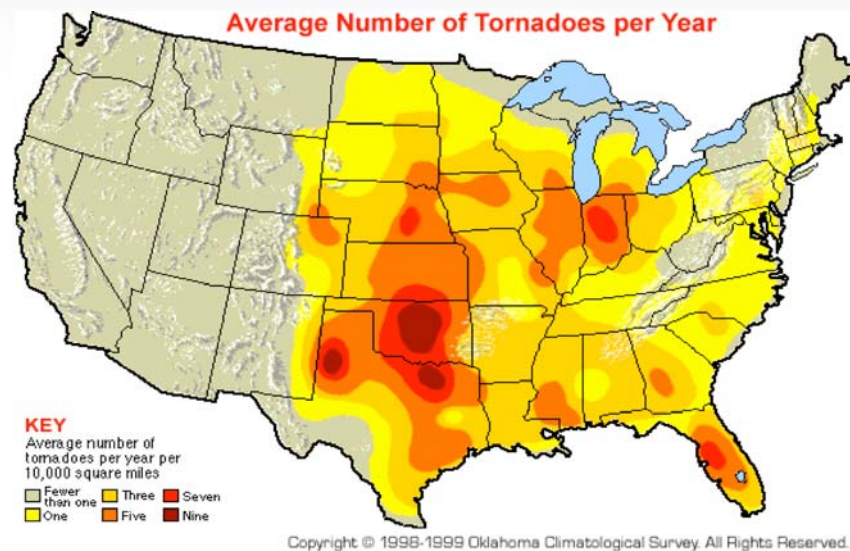
Key Issues

- **Two-Way Interface:** End users request and receive data from the system (fundamental shift in observing paradigm.)
- **Resource contention:** How the utility of weather information to end users and resource allocation policy determines sensing strategies and use of system resources.
- **Technical/Training Requirements:** Data formats, visualization, timing and spatial scales of forecasts for different end users.
- **Behavior/Perceptions:** Understanding end user decision making, response, communications, and perception of the strengths and limitations of current weather technology and severe warning systems.
- **Social, economic, and behavioral impacts pre and post CASA.**

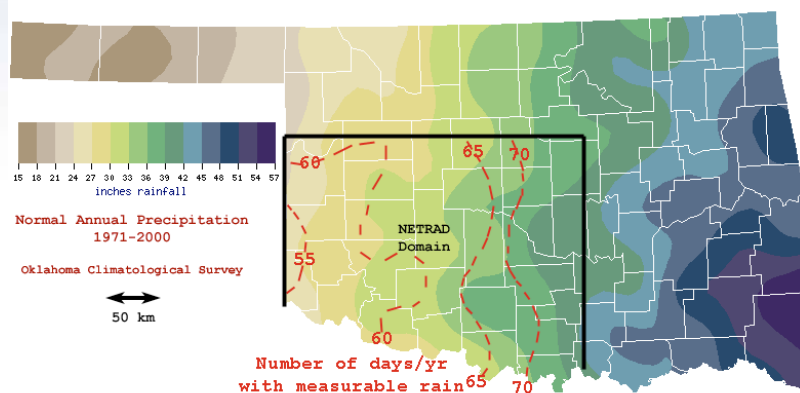


Why Oklahoma?

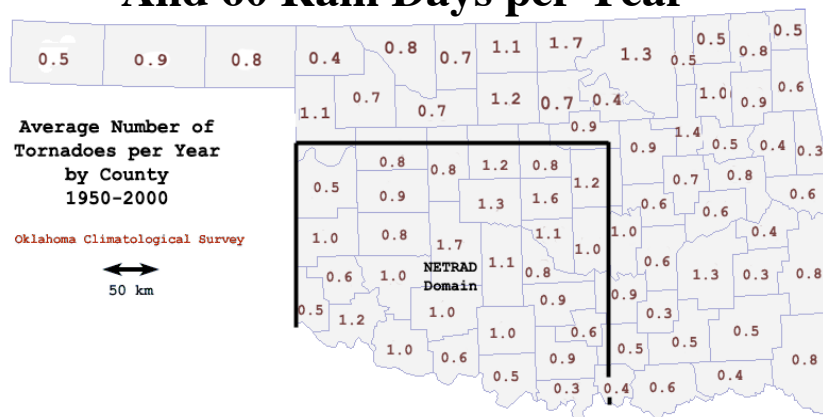
- Climatological focal point for
 - tornadoes, storm genesis, hail, dryline, microbursts, boundary-layer circulations, fronts
- Location of major field programs
- Co-located with other observing facilities, e.g., ARM/CART radiometers and profilers
- Serviced by 3 NEXRAD radars and 1 TDWR radar
- OneNet towers and partner buildings available
- OK-FIRST emergency managers, Earthstorm K-12 Schools, major TV markets
- Covers 4 US Military Bases + OKC Airport + Oklahoma Space Port
- Covers edge of Oklahoma winter wheat belt
- Oklahoma Mesonet and ARS Micronet



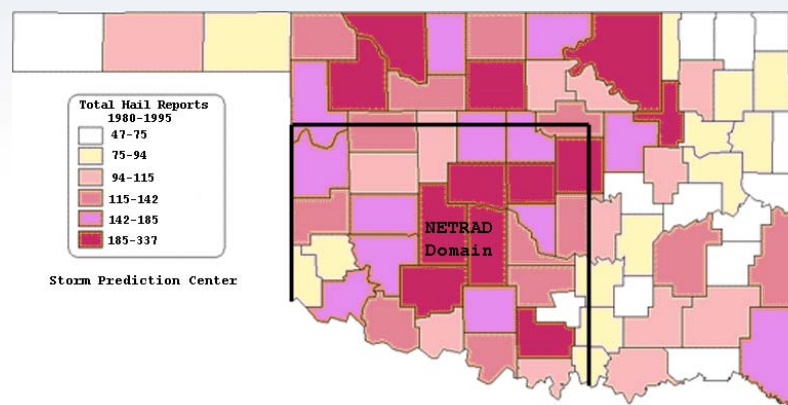
Who wants it?



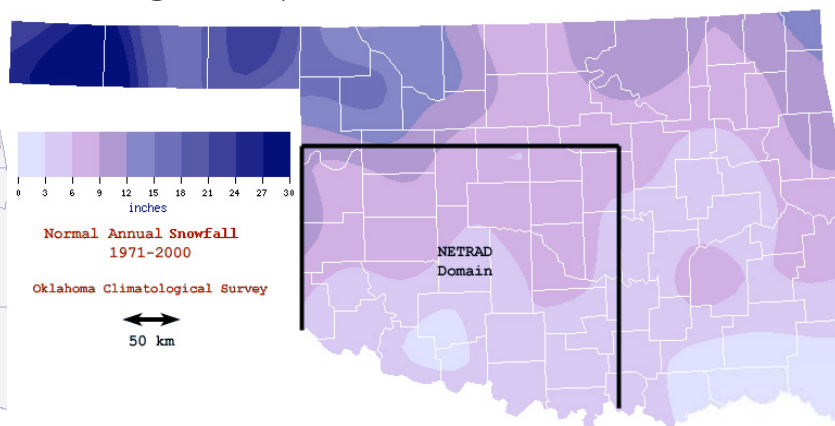
**Average Annual Rainfall 32 inches
And 60 Rain Days per Year**



**About 24 Tornadoes Per Year
Over NETRAD Domain**



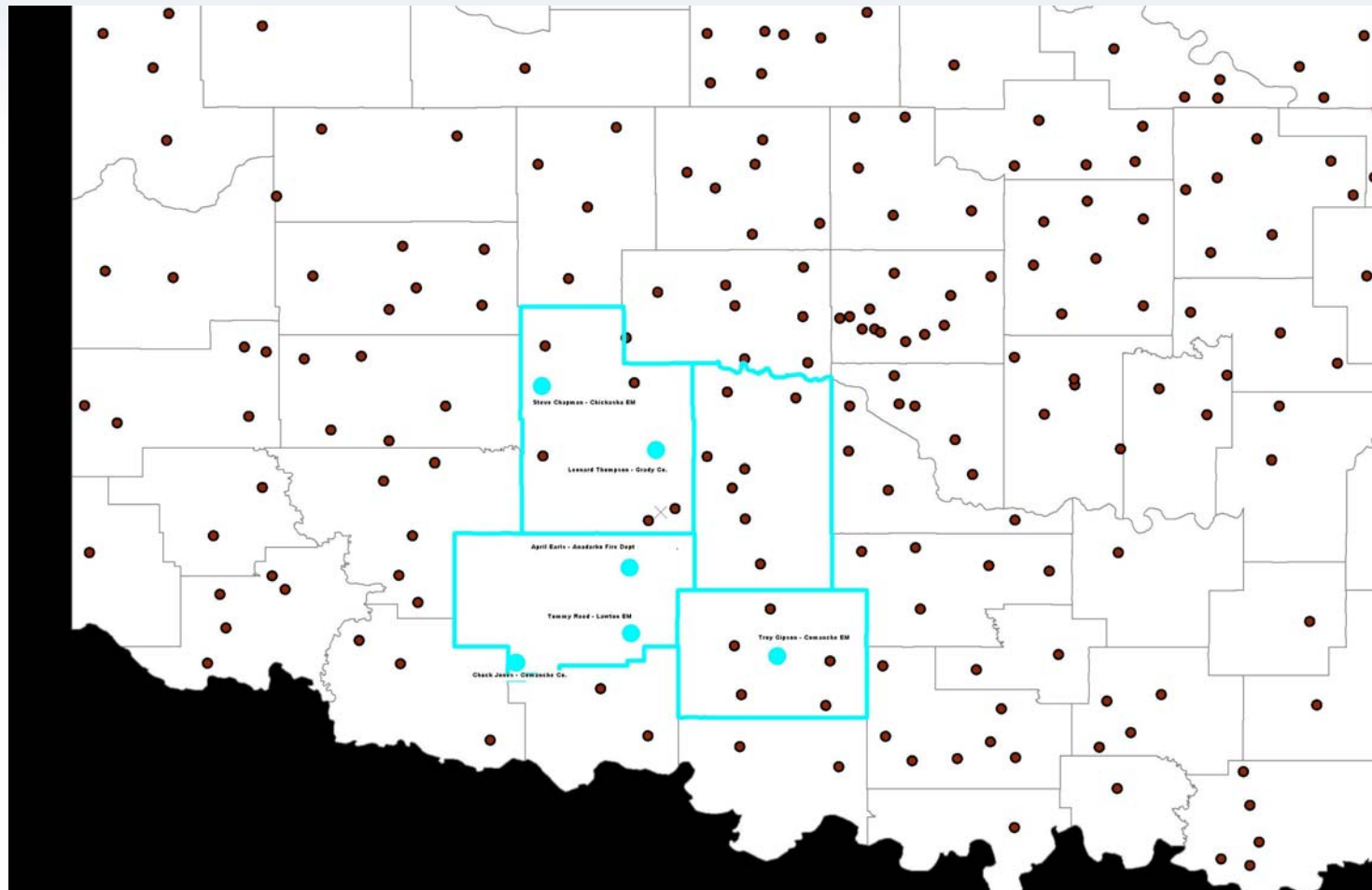
**More Than 200 Hail Reports Per
Year Over NETRAD Domain**



**Average 6 inches of Snowfall Over
NETRAD Domain**



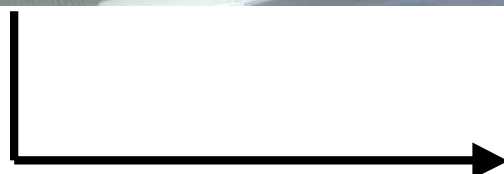
Test Bed Site – Sept 05-Mar 06



- Emergency Management Agencies



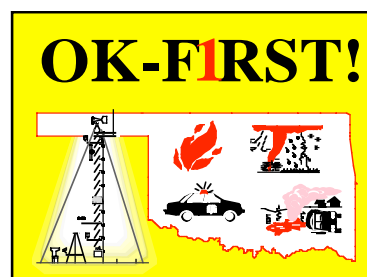
Work in Progress: Survey Data into Policy Tables



| User C. Baron Services | CURRENT STATE (T=0) and Policy Score | | | | | | | |
|------------------------|--------------------------------------|--|--|--|--|--|--|--|
| | | | | | | | | |

| User B. Vieux & Associates | CURRENT STATE (T=0) and Policy Score | | | | | | | |
|----------------------------|--------------------------------------|--|--|--|--|--|--|--|
| De de an | | | | | | | | |

| User A. NWS, OCS, EMs | CURRENT STATE (T=0) and Policy Score | | | | | | | |
|---|--------------------------------------|---|---|---|---|---|---|---|
| POLICY | T | F | M | H | S | R | C | G |
| Detect and track tornados when they are xx km from high density populations, xx km from med density populations, in any current state. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Detect and track severe weather (tornados, mesocyclones, storm cells, flooding rain) traveling NW in the test bed when it is xx miles or less from the Oklahoma City area | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Provide rainfall estimates wherever precipitation occurs at least every 2 minutes. | 1 | 3 | 1 | 2 | 2 | 2 | 2 | 1 |
| Provide precipitation estimates when accumulated rainfall is more than xx for the following river basins: x,y | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 |



Oklahoma System Capabilities - Desired

Capability 1 – Tornado Detection.

- (1a) Detect low level circulation associated with a tornado within 60 s of formation.
- (1b) Support research related to detecting signatures confirming low level circulation is in contact with the ground and has become a tornado.

Capability 2 – Tornado Pinpointing.

- (2a) Track centroid of low level circulation associated with a tornado with spatial errors < 300 m and temporal errors < 60 s.
- (2b) Support research related to tracking the point where a tornado is in contact with the ground.

Capability 3 – Tornado Anticipation.

- (3a) Support research and provide the real-time data necessary for future demonstration of warning algorithms that detect reliable, coherent signatures that precede tornadogenesis.

Capability 4 - Data Assimilation for Forecasting Models.

- (4a) Provide the real-time (3 sets at 1 minute intervals, every 15 minutes) data and
- (4b) Support research for future demonstration of model-based forecasting of severe storm threats.

Capability 5 – Nowcasting.

- (5a) Provide the real-time (1 minute update) data necessary for future nowcasting of severe storm threats (hail, severe winds, and storm cell development).

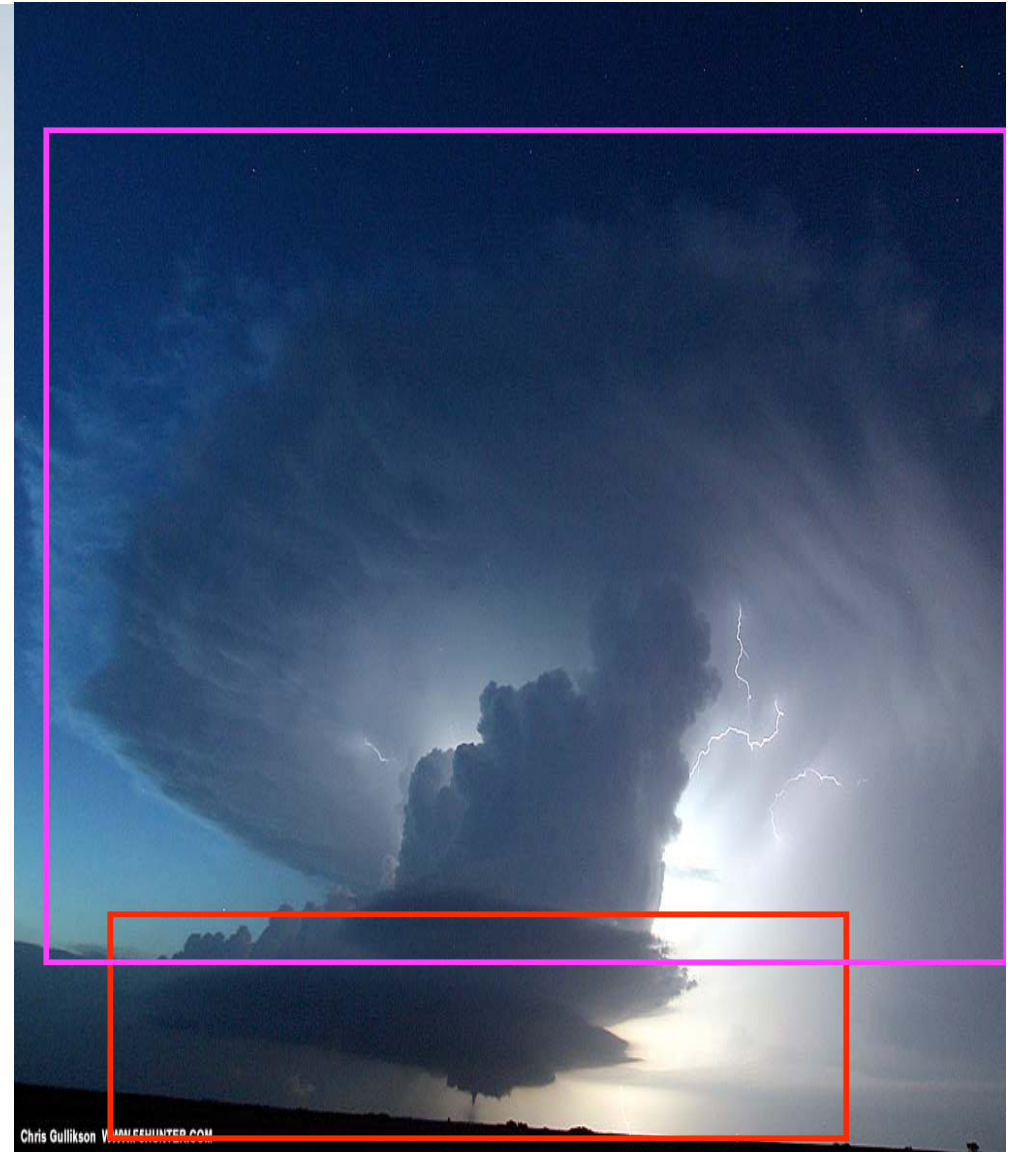
Capability 6 – End-User Integration and Optimization.

- (6a) Simultaneously provide severe weather and hazard data to operational end users; data for tornado anticipation, forecast models, and nowcasting to CASA researchers
- (6b) resolve resource contention among competing end user needs through end user policy.



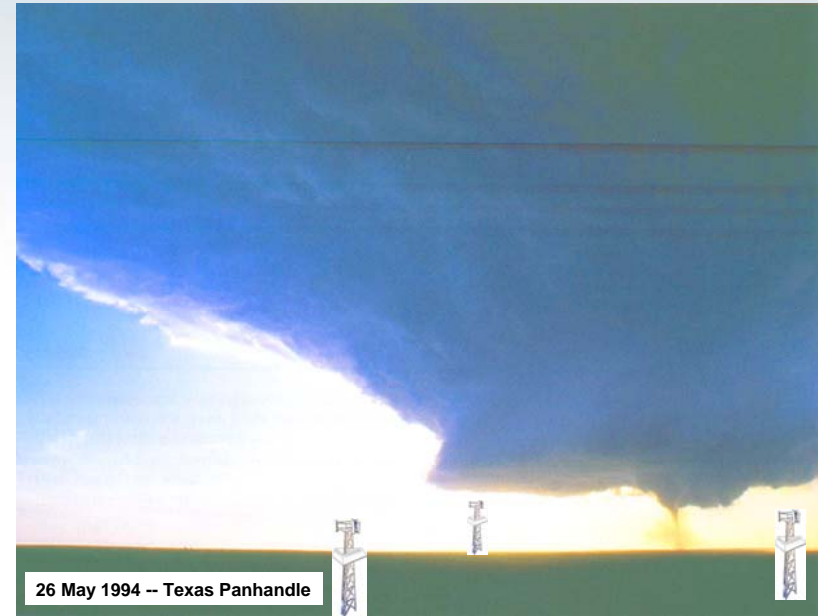
Anticipating Tornadoes

- What signatures within storms herald the development of tornadoes, and how do these vary among storm type and tornado intensity?
- Can multiple features be detected and interrelated in real time in order to anticipate tornado occurrence?
- How can NEXRAD data be added to CASA Radars and other information to improve our ability to anticipate tornadoes?

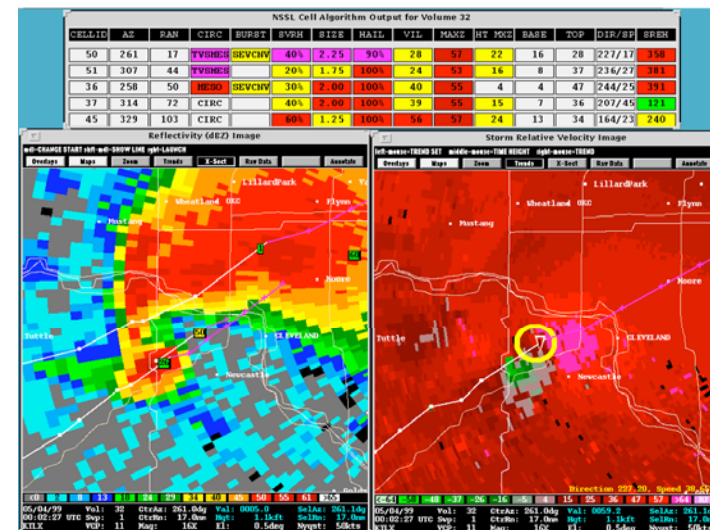
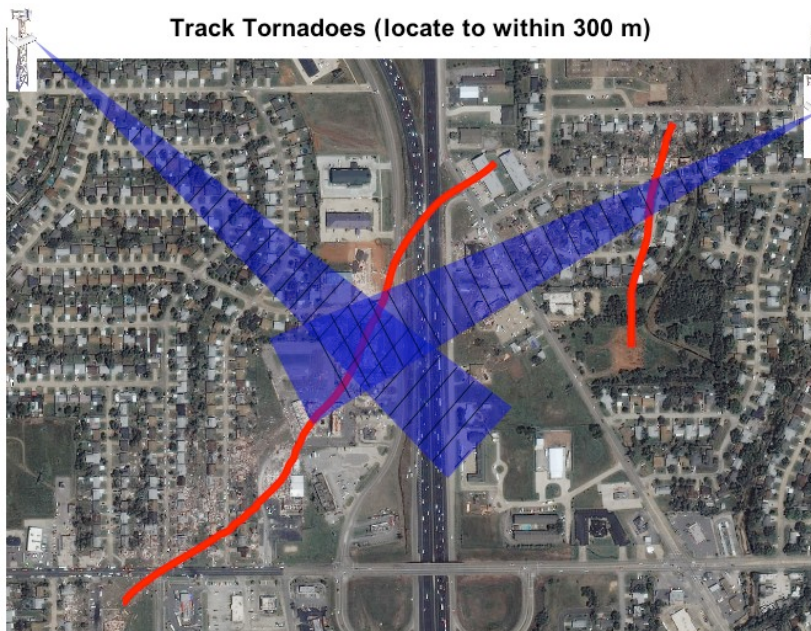


Localized Detection & Pinpointing

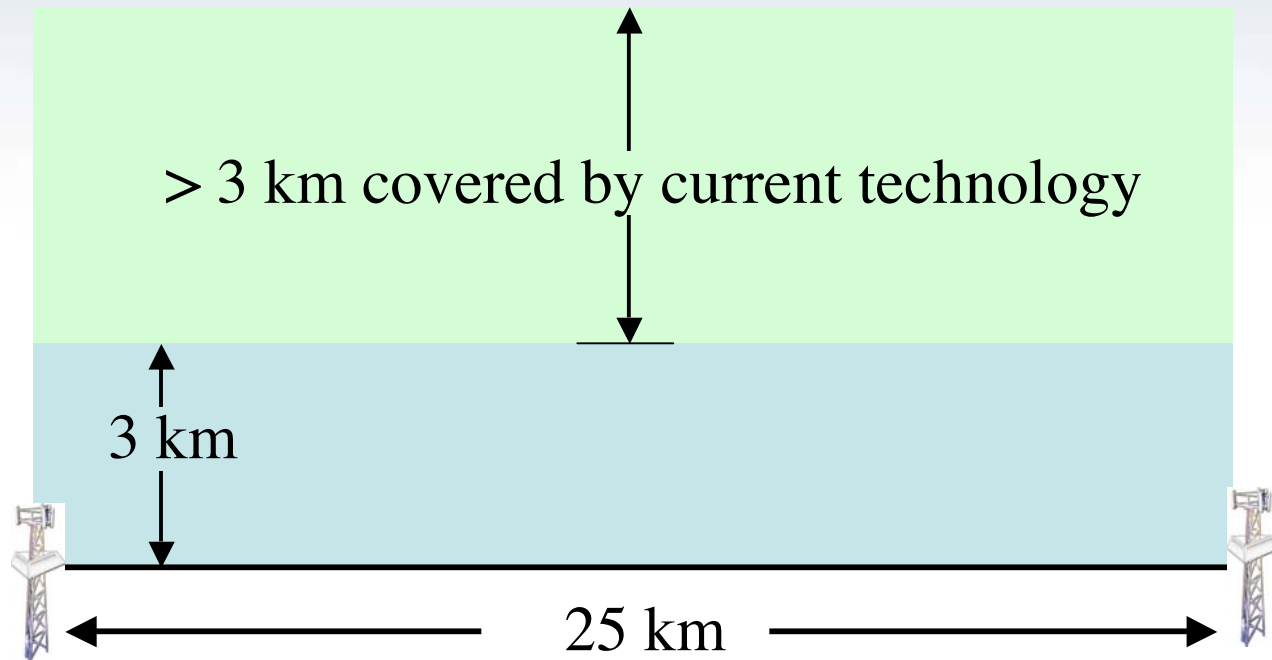
- ❑ How to sample a tornado? How to coordinate radar scanning strategies to pinpoint a tornado?
- ❑ How to modify existing detection algorithms for use in CASA radars?
- ❑ How to “knit” together NEXRAD & CASA radar data for a coherent picture to improve detection performance?



© 1998 Prentice-Hall, Inc. -- From: Lutgens and Tarbuck, *The Atmosphere*, 7th Ed.

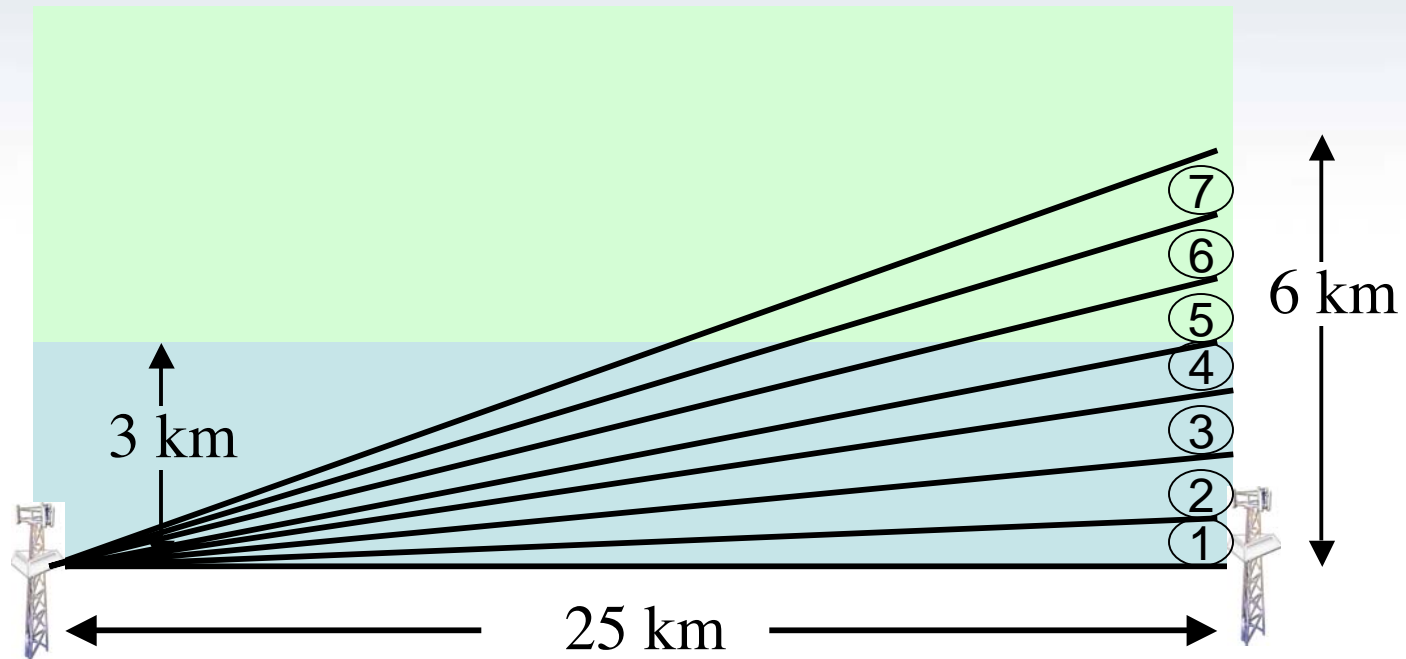


NetRad Concept



Goal: Map winds, rain below 3 km

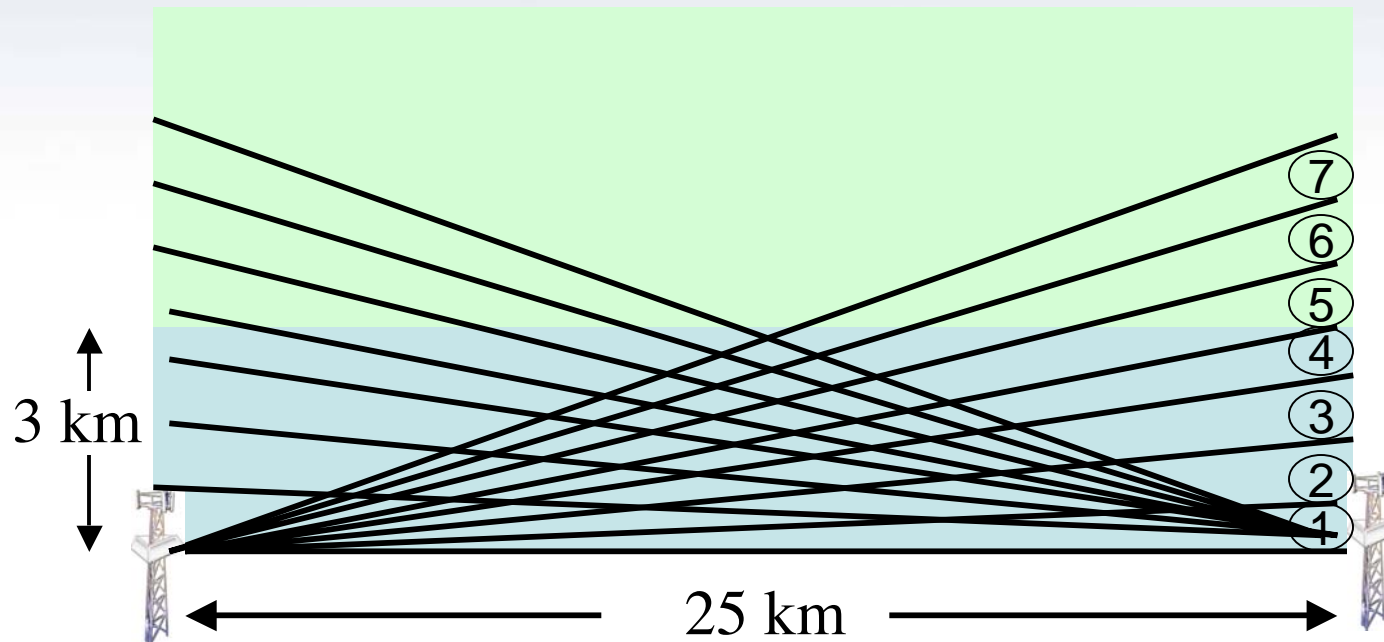
NetRad Concept



Goal: Map winds, rain below 3 km.

7 elevation beam positions scan 0°-14°

NetRad Concept



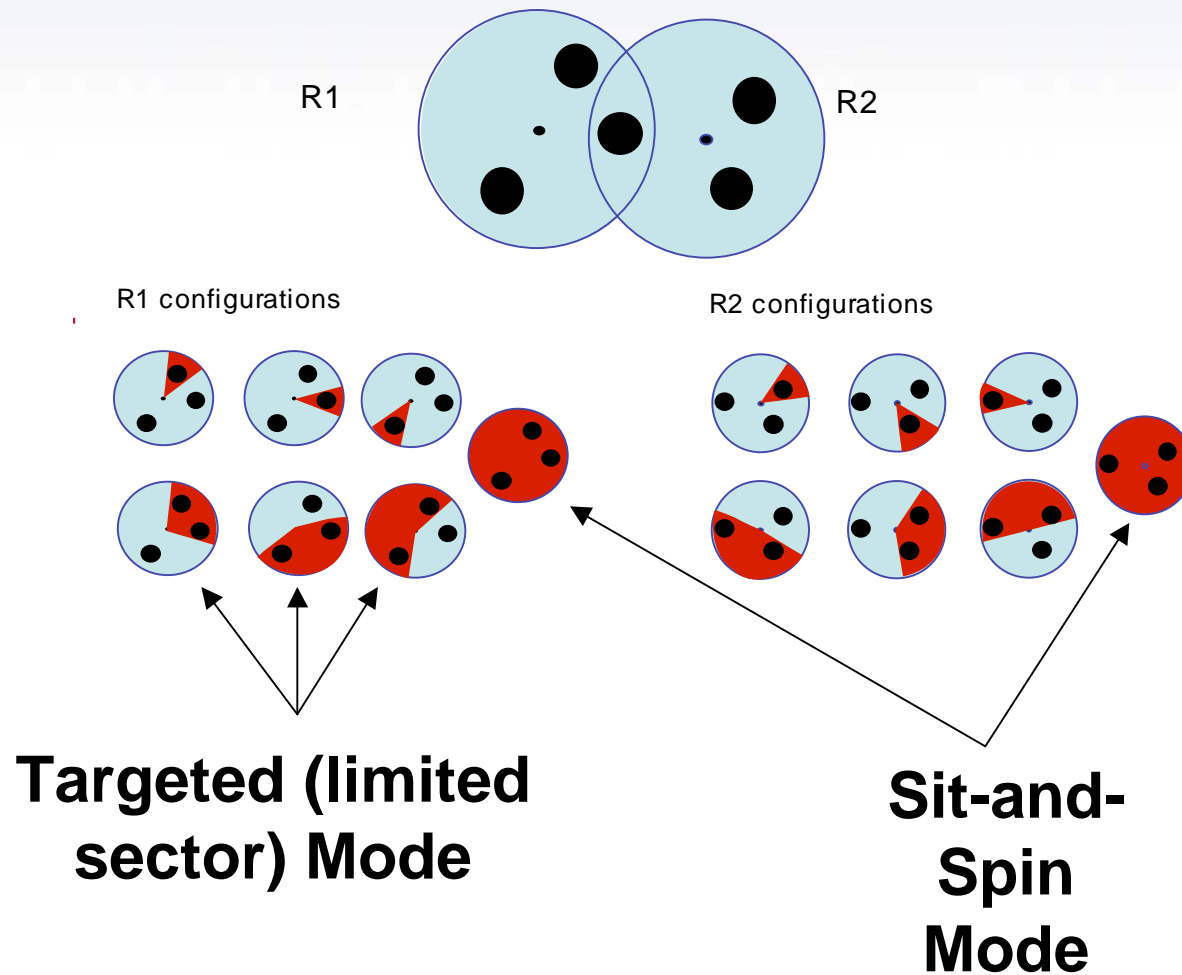
Goal: Map winds, rain below 3 km.

7 elevation beam positions scan 0°-14°

**Neighbor radars map “cone of silence” above a radar.
Multiple-Doppler wind measurement throughout.**



NetRad Sampling Modes



Coming this fall!!!

- First CASA radar will be deployed near Chickasha, OK in the fall of 2005
- Three other radars will be deployed in SW OK test bed during the next 2 years.
- Data will be available for researchers, NWS, and test bed emergency managers as early as Spring '06



Sensors Required for Nation-Wide Coverage

